

What is claimed is:

- 1 A radio-resource management method comprising a control step of, based on radio-link quality information to be notified from at least one of a plurality of radio base stations and radio terminals belonging to respective different operators, taking alteration control of a frequency that said radio base station utilizes.
- 10 2 The radio-resource management method according to claim 1, said radio-resource management method characterized in that said radio-link quality information includes at least a received level of a radio link and a quantity of interference with a neighboring radio system, and that said control step has a step of, in the event that a total of the received levels of other base stations utilizing a frequency identical to the frequency that said radio base station currently utilizes is larger than a total of the received levels of other base stations in the frequency other than the frequency that is currently utilized, out of the frequency that said radio base station can utilize, taking control so as to make an alteration to the frequency other than said frequency that is currently utilized.

3 The radio-resource management method according to
claim 1, wherein said radio-link quality information is
notified at a predetermined notification period.

5 4 The radio-resource management method according to
claim 3, wherein, in the event that a link quality of the
radio link exceeded a predetermined threshold, said
notification period is set to be longer than it is set in
the event that it is equal to or less than said threshold.

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5 The radio-resource management method according to
claim 3, wherein, in the event that a distribution value
of the link quality of the radio link measured within a
constant period exceeded a predetermined threshold, said
15 notification period is set to be longer than it is set in
the event that it is equal to or less than said threshold.

6 A radio-resource management method comprising a
control step of, based on radio-link quality information
20 to be notified from at least one of a plurality of radio
base stations and radio terminals belonging to respective
different operators, taking transmitted-power control for
said radio base station.

25 7 The radio-resource management method according to

claim 6, wherein said radio-link quality information includes at least a received level of a radio link, and that said control step has a step of, out of the radio base stations that utilize a frequency identical to the 5 frequency that said radio base station currently utilizes and yet belong to an identical radio operator, taking transmitted-power reduction control for the radio base station, of which the received level exceeded a first threshold, and of which current transmitted power is equal 10 to or more than a lower limit value.

8 The radio-resource management method according to claim 6, wherein said control step has a step of, out of the radio base stations that utilize a frequency identical 15 to the frequency that said radio base station currently utilizes and yet belong to a different radio operator, taking second transmitted-power reduction control for the radio base station, of which the received level exceeded a second threshold, and of which current transmitted power 20 is equal to or more than a lower limit value.

9 The radio-resource management method according to claim 6, wherein said radio-link quality information is notified at a predetermined notification period.

10 The radio-resource management method according to
claim 9, wherein, in the event that a link quality of the
radio link exceeded a predetermined threshold, said
notification period is set to be longer than it is set in
5 the event that it is equal to or less than said threshold.

11 The radio-resource management method according to
claim 9, wherein, in the event that a distribution value
of the link quality of the radio link measured within a
10 constant period exceeded a predetermined threshold, said
notification period is set to be longer than it is set in
the event that it is equal to or less than said threshold.

12 A radio-resource management method comprising a
15 control step of, based on radio-link quality information
to be notified from at least one of a plurality of radio
base stations and radio terminals belonging to respective
different operators, taking distribution control of a load
that is a radio terminal to be accommodated in said radio
20 base station.

13 The radio-resource management method according to
claim 12, said radio-resource management method
characterized in that said control step has a step of, in
25 the event that a number of the radio terminals to be

accommodated in said radio base station exceeded a predetermined threshold, taking distribution control of the load.

5 **14** The radio-resource management method according to claim 12, wherein said control step has a step of taking distribution control of the load concentrated in a network of a specific radio operator out of said plurality of said radio operators.

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15 The radio-resource management method according to claim 12, wherein said control step is adapted to take load-distribution control having cable-link quality information as well to be notified from said radio base 15 station taken into consideration.

16 The radio-resource management method according to claim 12, wherein said radio-link quality information is notified at a predetermined notification period.

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17 The radio-resource management method according to claim 16, wherein, in the event that a link quality of the radio link exceeded a predetermined threshold, said notification period is set to be longer than it is set in 25 the event that it is equal to or less than said threshold.

18 The radio-resource management method according to
claim 16, wherein, in the event that a distribution value
of the link quality of the radio link measured within a
5 constant period exceeded a predetermined threshold, said
notification period is set to be longer than it is set in
the event that it is equal to or less than said threshold.

19 A radio-resource management method comprising a
10 control step of, based on radio-link quality information
to be notified from at least one of a plurality of radio
base stations and radio terminals belonging to respective
different operators, detecting an interference state
between the operators to take fault-notification control
15 according to this detected result.

20 The radio-resource management method according to
claim 19, said radio-resource management method
characterized in that said control step has a step of, in
20 the event that radio interference having a pre-specified
value or more from the other radio operator was detected
within a network of a certain radio operator, making fault
notification to a network management server of the radio
operator that is an interference source.

21 The radio-resource management method according to
claim 20, wherein said control step has a step of, in
addition to said fault notification, making notification
of anyone of an interference quantity, a transmitted-power
5 quantity that the radio base station should attenuate, and
a frequency that the radio base station should alter, or a
combination thereof as well.

22 The radio-resource management method according to
10 claim 19, wherein said radio-link quality information is
notified at a predetermined notification period.

23 The radio-resource management method according to
claim 22, wherein, in the event that a link quality of the
15 radio link exceeded a predetermined threshold, said
notification period is set to be longer than it is set in
the event that it is equal to or less than said threshold.

24 The radio-resource management method according to
20 claim 22, wherein, in the event that a distribution value
of the link quality of the radio link measured within a
constant period exceeded a predetermined threshold, said
notification period is set to be longer than it is set in
the event that it is equal to or less than said threshold.

25 A radio-resource management apparatus comprising controller for, based on radio-link quality information to be notified from at least one of a plurality of radio base stations and radio terminals belonging to respective 5 different operators, taking alteration control of a frequency that said radio base station utilizes.

26 The radio-resource management apparatus according to claim 25, said radio-resource management apparatus 10 characterized in that said radio-link quality information includes at least a received level of a radio link and a quantity of interference with a neighboring radio system, and that said controller has means for, in the event that a total of the received levels of other base stations 15 utilizing a frequency identical to the frequency that said radio base station currently utilizes is larger than a total of the received levels of other base stations in the frequency other than the frequency that is currently utilized out of the frequencies that said radio base 20 station can utilize, taking control so as to make an alteration to the frequency other than said frequency that is currently utilized.

27 A radio-resource management apparatus comprising 25 controller for, based on radio-link quality information to

be notified from at least one of a plurality of radio base stations and radio terminals belonging to respective different operators, taking transmitted-power control for said radio base station.

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28 The radio-resource management apparatus according to claim 27, wherein said radio-link quality information includes at least a received level of a radio link, and that said controller has means for, out of the radio base 10 stations that utilize a frequency identical to the frequency that said radio base station currently utilizes, and yet belong to an identical radio operator, taking transmitted-power reduction control for the radio base station, of which the received level exceeded a first 15 threshold, and of which current transmitted power is equal to or more than a lower limit value.

29 The radio-resource management apparatus according to claim 27, wherein said controller has means for, out of 20 the radio base stations that utilize a frequency identical to the frequency that said radio base station currently utilizes, and yet belong to a different radio operator, taking second transmitted-power reduction control for the radio base station, of which the received level exceeded a 25 second threshold, and of which current transmitted power

is equal to or more than a lower limit value.

30 A radio-resource management apparatus comprising controller for, based on radio-link quality information to 5 be notified from at least one of a plurality of radio base stations and radio terminals belonging to respective different operators, taking distribution control of a load that is a radio terminal to be accommodated in said radio base station.

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31 The radio-resource management apparatus according to claim 30, wherein said controller has means for, in the event that a number of the radio terminals to be accommodated in said radio base station exceeded a 15 predetermined threshold, taking distribution control of the load.

32 The radio-resource management apparatus according to claim 30, wherein said controller has means for taking 20 distribution control of the load concentrated in a network of a specific radio operator out of said plurality of said radio operators.

33 The radio-resource management apparatus according to 25 claim 30, wherein said controller is adapted to take load-

distribution control having cable-link quality information as well to be notified from said radio base station taken into consideration.

5 **34** A radio-resource management apparatus comprising controller for, based on radio-link quality information to be notified from at least one of a plurality of radio base stations and radio terminals belonging to respective different operators, detecting an interference state
10 between the operators to take fault-notification control according to this detected result.

15 **35** The radio-resource management apparatus according to claim 34, wherein said controller has means for, in the event that radio interference having a pre-specified value or more from the other radio operator was detected within a network of a certain radio operator, making fault notification to a network management server of the radio operator that is an interference source.

20 **36** The radio-resource management apparatus according to claim 35, wherein said controller has means for, in addition to said fault notification, notifying anyone of an interference quantity, a transmitted-power quantity
25 that the radio base station should attenuate, and a

frequency that the radio base station should alter, or a combination thereof as well.

37 A radio base station in a wireless network system
5 including a radio-resource management apparatus for
managing a radio resource, and radio base stations
belonging to a plurality of respective different radio
operators, said radio base station comprising:

means for measuring a quality of a radio link and
10 notifying radio-link quality information that is this
measured result to said radio-resource management
apparatus; and

means for, in reply to alteration-control notification
of a frequency based on said measured result from said
15 radio-resource management apparatus, taking alteration
control of a service frequency.

38 The radio base station according to claim 37,
wherein said means for notifying comprises means for
20 notification makes notification at a predetermined
notification period.

39 The radio base station according to claim 38,
wherein, in the event that the radio-link quality exceeded
25 a predetermined threshold, said notification period is set

to be longer than it is set in the event that it is equal to or less than said threshold.

40 The radio base station according to claim 38,
5 wherein, in the event that a distribution value of the
radio-link quality measured within a constant period
exceeded a predetermined threshold, said notification
period is set to be longer than it is set in the event
that it is equal to or less than said threshold.

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41 A radio base station in a wireless network system
including a radio-resource management apparatus for
managing a radio resource, and radio base stations
belonging to a plurality of respective different radio
15 operators, said radio base station comprising:

means for measuring a quality of a radio link and
notifying radio-link quality information that is this
measured result to said radio-resource management
apparatus; and

20 means for, in reply to transmitted-power control based
on said measured result from said radio-resource
management apparatus, taking alteration control of
transmitted power.

25 42 The radio base station according to claim 41,

wherein said means for notifying comprises means for notification makes notification at a predetermined notification period.

5 **43** The radio base station according to claim 42, wherein, in the event that the radio-link quality exceeded a predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal to or less than said threshold.

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44 The radio base station according to claim 42, wherein, in the event that a distribution value of the radio-link quality measured within a constant period exceeded a predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal to or less than said threshold.

15 **45** A radio terminal in a wireless network system including a radio-resource management apparatus for managing a radio resource, and radio base stations belonging to a plurality of respective different radio operators, said radio terminal comprising:

20 means for measuring a quality of a radio link and notifying radio-link quality information that is this measured result to said radio-resource management

apparatus; and

means for, in reply to alteration-control notification of a frequency based on said measured result from said radio-resource management apparatus, taking alteration
5 control of a service frequency.

46 The radio terminal base station according to claim 45, wherein said means for notifying makes notification at a predetermined notification period.

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47 The radio terminal according to claim 46, wherein, in the event that the radio-link quality exceeded a predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal
15 to or less than said threshold.

48 The radio terminal according to claim 47, wherein, in the event that a distribution value of the radio-link quality measured within a constant period exceeded a
20 predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal to or less than said threshold.

49 A radio terminal in a wireless network system
25 including a radio-resource management apparatus for

managing a radio resource, and radio base stations belonging to a plurality of respective different radio operators, said radio terminal comprising:

means for measuring a quality of a radio link and
5 notifying radio-link quality information that is this measured result to said radio-resource management apparatus; and

means for, in reply to transmitted-power control based on said measured result from said radio-resource
10 management apparatus, taking alteration control of transmitted power.

50 The radio terminal base station according to claim 49, wherein said means for notifying makes notification at
15 a predetermined notification period.

51 The radio terminal according to claim 50, wherein, in the event that the radio-link quality exceeded a predetermined threshold, said notification period is set
20 to be longer than it is set in the event that it is equal to or less than said threshold.

52 The radio terminal according to claim 50, wherein, in the event that a distribution value of the radio-link
25 quality measured within a constant period exceeded a

predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal to or less than said threshold.

5 **53** A radio terminal in a wireless network system including a radio-resource management apparatus for managing a radio resource, and radio base stations belonging to a plurality of respective different radio operators, said radio terminal comprising:

10 means for measuring a quality of a radio link and notifying radio-link quality information that is this measured result to said radio-resource management apparatus; and

15 base-station alteration control means for, in reply to distribution control of a connected radio terminal based on said measured result from said radio-resource management apparatus, taking alteration control of a connected base station.

20 **54** The radio terminal base station according to claim 53, wherein said means for notifying makes notification at a predetermined notification period.

25 **55** The radio terminal according to claim 54, wherein, in the event that the radio-link quality exceeded a

predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal to or less than said threshold.

5 **56** The radio terminal according to claim 54, wherein, in the event that a distribution value of the radio-link quality measured within a constant period exceeded a predetermined threshold, said notification period is set to be longer than it is set in the event that it is equal
10 to or less than said threshold.

5 **57** A computer-readable program for causing a computer to execute a control operation of a radio-resource management apparatus in a wireless network system, said
15 program characterized in including a frequency control step of, based on radio-link quality information to be notified from at least one of radio base stations and radio terminals belonging to respective different operators, taking alteration control of a frequency that
20 said radio base station utilizes.

5 **58** A computer-readable program for causing a computer to execute a control operation of a radio-resource management apparatus in a wireless network system, said
25 program characterized in including a transmitted-power

control step of, based on radio-link quality information to be notified from at least one of radio base stations and radio terminals belonging to respective different operators, taking transmitted-power control for said radio
5 base station.

59 A computer-readable program for causing a computer to execute a control operation of a radio-resource management apparatus in a wireless network system, said
10 program characterized in including a load-distribution control step of, based on radio-link quality information to be notified from at least one of radio base stations and radio terminals belonging to respective different operators, taking load-distribution control of a load that
15 is a radio terminal to be connected to said radio base station.

60 A computer-readable program for causing a computer to execute a control operation of a radio-resource management apparatus in a wireless network system, said
20 program characterized in including a step of, based on radio-link quality information to be notified from at least one of radio base stations and radio terminals belonging to respective different operators, notifying
25 anyone of occurrence of a fault and an interference

quantity, a transmitted-power quantity that the radio base station should attenuate, and a frequency that the radio base station should alter, or a combination thereof to a network management server of the radio operator that is an

5 interference source in the event that radio interference having a pre-specified value or more from the other radio operator was detected within a network of a certain radio operator.

10 **61** A computer-readable program for causing a computer to execute a control operation of a radio base station in a wireless network system including a radio-resource management apparatus for managing a radio resource, and radio base stations belonging to a plurality of respective

15 different radio operators, said program characterized in including the steps of:

measuring a quality of a radio link to notify radio-link quality information that is this measured result to said radio-resource management apparatus; and

20 in reply to alteration-control notification of a frequency based on said measured result from said radio-resource management apparatus, taking alteration control of a service frequency.

25 **62** A computer-readable program for causing a computer

to execute a control operation of a radio base station in
a wireless network system including a radio-resource
management apparatus for managing a radio resource, and
radio base stations belonging to a plurality of respective
5 different radio operators, said program characterized in
including the steps of:

measuring a quality of a radio link to notify radio-
link quality information that is this measured result to
said radio-resource management apparatus; and

10 in reply to transmitted-power control based on said
measured result from said radio-resource management
apparatus, taking alteration control of transmitted power.

63 A computer-readable program for causing a computer
15 to execute a control operation of a radio terminal in a
wireless network system including a radio-resource
management apparatus for managing a radio resource, and
radio base stations belonging to a plurality of respective
different radio operators, said program characterized in
20 including the steps of:

measuring a quality of a radio link to notify radio-
link quality information that is this measured result to
said radio-resource management apparatus; and

25 in reply to alteration-control notification of a
frequency based on said measured result from said radio-

resource management apparatus, taking alteration control of a service frequency.

64 A computer-readable program for causing a computer 5 to execute a control operation of a radio terminal in a wireless network system including a radio-resource management apparatus for managing a radio resource, and radio base stations belonging to a plurality of respective different radio operators, said program characterized in 10 including the steps of:

measuring a quality of a radio link to notify radio-link quality information that is this measured result to said radio-resource management apparatus; and

15 in reply to transmitted-power control based on said measured result from said radio-resource management apparatus, taking alteration control of transmitted power.

65 A computer-readable program for causing a computer to execute a control operation of a radio terminal in a 20 wireless network system including a radio-resource management apparatus for managing a radio resource, and radio base stations belonging to a plurality of respective different radio operators, said program characterized in including the steps of:

25 measuring a quality of a radio link to notify radio-

link quality information that is this measured result to said radio-resource management apparatus; and

in reply to distribution control of a connected radio terminal based on said measured result from said radio-
5 resource management apparatus, taking alteration control of a connected base station.

66 A radio-resource management system comprising:

means for collecting a link quality, a link availability ratio, and a link communication speed of a radio link from at least one of radio base stations and radio terminals belonging to a plurality of respective different operators; and

price decision means for deciding a price at which a communication service via a network of each of said plurality of said operators is offered to an external network responding to these collected results to notify it to said external network.

20 **67** The radio-resource management system according to claim 66, wherein said price decision means decides said price with a pre-decided price function to be decided by said link quality, said link availability ratio, and said link communication speed of said radio link.

68 The radio-resource management system according to
claim 66, wherein each of said means is provided in a
radio-resource management apparatus to be operated by a
third-party organ that is independent from said plurality
5 of said operators.

69 The radio-resource management system according to
claim 68, wherein said price decision means makes price
decision so that said price is equal to or less than a
10 pre-decided upper limit value in compensation for a
management fee for operating said radio-resource
management apparatus that was paid from said external
network.

15 **70** The radio-resource management system according to
claim 69, said radio-resource management system
characterized in being adapted so that said radio-resource
management apparatus offers a communication service to the
operator of said external network at a then price in the
20 event that said price is equal to or less than said upper
limit value, and restrains said price to said upper limit
value in the event that it exceeded said upper limit value.

25 **71** A radio-resource management system including a
radio-resource management server that a radio-resource

manager possesses, and radio facilities of a radio communication operator who made a management contract with this radio-resource manager, said radio-resource management system characterized in that said radio-
5 resource management server includes:

fault process means for supervising a communication status of said radio communication operator to perform a fault process for said radio resource in reply to occurrence of a fault; and

10 fee charging means for charging a management service fee of said radio resource to said radio communication operator.

72 The radio-resource management system according to
15 claim 71, wherein said fault process means supervises said communication status based on radio-link quality information to be notified from said radio facilities.

73 The radio-resource management system according to
20 claim 71, wherein said fault process means supervises an interference state of said radio resource to take frequency-alteration control or transmitted-power control of said radio facilities.

25 74 The radio-resource management system according to

claim 71, wherein said radio-resource management server further includes notification means for, in reply to occurrence of the fault other than said interference state, notifying occurrence of the fault to said radio
5 communication operator.

75 The radio-resource management system according to claim 74, said radio-resource management system characterized in that said notification means is
10 configured to notify an avoidance countermeasure of said fault as well.

76 The radio-resource management system according to claim 75, said radio-resource management system
15 characterized in that said occurrence notification and said avoidance-countermeasure notification of said fault are of service class that is selectable by said radio communication operator, and that said fee charging means is adapted to charge a service fee according to said
20 service class.